

REMARKS

This is a full and timely response to the Office Action mailed December 04, 2007.

By this Amendment, claims 10 and 14 have been amended to more particularly define the present intention. Thus, claims 1-16 are currently pending in this application. Support for the claim amendments can be readily found variously throughout the specification and the original claims.

In view of these amendments, Applicant believes that all pending claims are in condition for allowance. Reexamination and reconsideration in light of the above amendments and the following remarks is respectfully requested.

Rejections under 35 U.S.C. §102 and §103

Claims 10-12, 14 and 15 are rejected under 35 U.S.C. §102(e) as allegedly been anticipated by Etoh et al. (U.S. Patent No. 6,972,795). Further, claims 13 and 16 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Etoh et al., either alone or in combination with Mizutani et al. (U.S. Patent No. 6,144,407). Applicant respectfully traverses these rejections.

To constitute anticipation of the claimed invention under U.S. practice, the prior art reference must literally or inherently teach each and every limitation of the claims. Further, to establish a *prima facie* case of obviousness, the prior art reference(s) must teach or suggest all the claim limitations. Here, in this case, Applicant believes that Etoh et al., either alone or in combination with Mizutani et al., fails to teach or suggest all the limitations of the claims with particular emphasis on the limitation “*said light receiver, said readout unit and said plurality of storage units are arranged in series, and a first drain structure is disposed adjacent a storage unit adjacent the readout unit or the readout unit for discharging excess part of the electric signals read by said readout unit*”.

The Examiner indicates that (1) the light receiver in the present invention corresponds to photodiode 30a, 30b in Etoh et al., (2) the readout unit in the present invention corresponds to CCD transfer path 33a, 33b and drain gate 35a in Etoh et al., and (3) the storage units in the present invention corresponds to charge collecting well 31a in Etoh et al. However, Applicant respectfully disagrees with the Examiner’s conclusions in this regard.

Although Applicant believes that the Examiner is correct regarding the correspondence between the light receiver in the present invention and photodiode 30a, 30b in Etoh et al., Applicant believes that the other relationships (readout unit = CCD transfer path 33a, 33b and drain gate 35a; and storage units = charge collecting well 31a) are in error.

In the present invention, electric signals are read in order of light receiver → readout unit → storage units. In contrast, in Etoh et al., electric signals are read in the order of photodiode 30a, 30b → charge collecting well 31a → input gate 32a → CCD transfer path 33a → drain gate 35a → drain 36a (drain 36a). Therefore, in matching the relationship between the elements of the present invention and those of Etoh et al., the light receiver of the present invention = photodiode 30a, 30b of Etoh et al., the readout unit of the present invention = input gate 32a of Etoh et al., and the storage units of the present invention = CCD transfer path 33a of Etoh et al. The drain gate 35a, drain 36a and overflow gate 48 are arranged upstream of the charge collecting well 31a. Thus, Etoh et al. does not at all disclose or suggest a first drain structure disposed adjacent the storage unit (the most upstream cell of CCD transfer path 33a in Etoh et al.) adjacent to the readout unit (input gate 32a in Etoh et al.) or adjacent the readout as in the present invention.

Nevertheless, to clarify the claimed invention, Applicant has amended claims 10 and 14 of the present application to make clear the arrangement relationship between the light receiver, readout unit and the plurality of storage units and the order of reading electric signals.

Thus, for these reasons, Applicant believes that the present claims are not anticipated by or rendered obvious over Etoh et al., either alone or when combined with Mizutani et al. Hence, withdraw of these rejections is respectfully requested.

Claims 1-8 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Etoh et al. in view of Nakashiba (U.S. Patent No. 5,589,698). Further, claim 9 is rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Etoh et al. in view of Nakashiba and further in view of Mizutani et al. (U.S. Patent No. 6,144,407) Applicant respectfully traverses these rejections.

As noted above, to establish a *prima facie* case of obviousness, the following three criteria must be satisfied. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the

reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference(s) must teach or suggest all the claim limitations. Here, in this case, Applicant believes that the combinations of Etoh et al. and Nakashiba, and Etoh et al., Nakashiba and Mizutani et al., fail to teach or suggest all the limitations of the claims with particular emphasis on the limitation “*a potential gradient is provided in which potentials about the electric signals gradually change from the light receiver toward said readout unit*”.

The image sensor and related apparatus of the present invention comprises a light receiver as a light to electric signal converter and a gate electrode as a readout unit. A potential gradient in a light receiver is accomplished by gradually enlarging a width of impurities or by increasing density of impurities forming said light receiver, from the light receiver to the readout unit. As indicated in Fig 2(a) and Fig 9, a photodiode, i.e., a light receiver, may be shaped like letter characters “x” or “y” which can provide continuous and smooth changes of electric potential from near the center to the gate electrode (Fig 2(b)). Thus, the electric signals do not stagnate in the center while moving toward the gate electrode.

In contrast, although Etoh et al. discusses a potential gradient used in a photodiode to accelerate charge collection, as noted by the Examiner, Etoh et al. does not explicitly disclose how a potential gradient is provided and in what direction. The Examiner attempts to cure this deficiency in Etoh et al. by citing the teachings of Nakashiba. However, Nakashiba does not disclose changing potentials uniformly and smoothly. Given the teachings of Nakashiba, there is a strong possibility that electric signals stagnate in the center of the region. In Fig. 2B of Nakashiba, the potential gradient has a flat part in the central portion of the area, and thus the potentials do not change gradually as in the present invention. Therefore, in Nakashiba, it is clear that electric signals could stagnate.

In addition, Nakashiba transfers electric signals from the vertical charge transfer section to the horizontal charge transfer section. This is different from the present invention which transfers electric signals from the light receiver to the readout unit.

Further, Nakashiba transfers electric signals as they are from the vertical charge transfer section to the horizontal charge transfer section. In contrast, in the present invention, the light receiver receives light and converts it into electric signals, and then transfers the electric signals to

the readout unit. Thus, Applicant strongly believes that there can be no motivation for utilizing the potential gradient technique in transferring electric signals from the vertical charge transfer section to the horizontal charge transfer section as in Nakashiba, in receiving light and converting into electric signals at the light receiver, and then transferring the electric signals to the readout unit as in the present invention.


Thus, for these reasons, Applicant believes that the present claims are not obvious over the combined teachings and suggestions of Etoh et al., Nakashiba and Mizutani et al. Hence, withdraw of these rejections is respectfully requested.

CONCLUSION

For the foregoing reasons, all the claims now pending in the present application are believed to be clearly patentable over the outstanding rejections. Accordingly, favorable reconsideration of the claims in light of the above remarks is courteously solicited. If the Examiner has any comments or suggestions that could place this application in even better form, the Examiner is requested to telephone the undersigned attorney at the below-listed number.

Dated: March 4, 2008

Respectfully submitted,

By:  _____

Lee Cheng

Registration No.: 40,949

CHENG LAW GROUP PLLC

1100 17th Street, N.W.

Suite 503

Washington, DC 20036

(202) 530-1280

Attorneys for Applicant

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